EXHIBIT 4

Exhibit 4
Exemplary Infringement – '930 Patent, claim 6

Arista (A) directly infringed, (B) contributorily infringed, and (C) induced infringement claim 6 of the '930 Patent.

(A) Direct infringement. Arista directly infringed claim 6 of the '930 Patent by practicing a method for remotely powering access equipment in a data network that satisfied all of the claimed elements of claim 6 as described below.

In directly infringing claim 6 of the '930 Patent by practicing such a method, (a) the power sourcing equipment [1] (data nodes) and powered devices (access devices) used by Arista can both be Arista products, (b) neither can be Arista products (that is, Arista can use power sourcing equipment (data nodes) and powered devices (access devices) made by others), or (c) either the power sourcing equipment (data nodes) or the powered devices (access devices) can be Arista products, that satisfies all of the claimed elements as described below.

[1] The IEEE 802.3 standards (including 802.3af and 802.3at) use their own terminology to describe what is referred to in the '930 Patent as the (a) "data signaling pair," (b) "data node," and (c) "access device:"

"1.4 Definitions …

- 1.4.x Twisted Pair Medium Dependent Interface (TP MDI): The mechanical and electrical interface between the transmission medium and the Medium Attachment Unit (MAU) or PHY, *e.g.*, (10BASE-T, 100BASE-TX, or 1000BASE-T) [the "TP MDI" corresponds to the interface of the "data signaling pair" used in the claims of the '930 Patent].
- 1.4.x Power sourcing Equipment (PSE): A DTE or midspan that provides the power to a single link section. DTE powering is intended to provide a single 10BASE-T, 100BASE-T, or 1000BASE-T device with a unified interface for both the data it requires and the power to process these data [the "PSE" corresponds to the "data node" used in the claims of the '930 Patent].
- 1.4.x Powered Device (PD): A device that is either drawing power or requesting power from a PSE [the "PD" corresponds to the "access device" used in the claims of the '930 Patent]."

(B) Contributory infringement. Arista contributed to infringing claim 6 of the '930 Patent by making, importing, selling, and offering to sell:

(1) power sourcing equipment (data nodes) that, when combined and connected to powered devices (access devices) that are either Arista powered devices (access devices) or are powered devices (access devices) made by others, are designed, sold, and imported with the knowledge that they are especially made or adapted for use as a material part of a combination that practices the method of claim 6 for remotely powering access equipment in a data network, that satisfies all of the claimed elements as described below; and

(2) powered devices (access devices) that, when combined and connected to power sourcing equipment (data nodes) that are either Arista power sourcing equipment (data nodes) or are power sourcing equipment (data node) made by others, are designed, sold, and imported with the knowledge that they are especially made or adapted for use as a material part of combination that practices the method of claim 6 for remotely powering access equipment in a data network, that satisfies all of the claimed elements as described below.

(C) Induced infringement. Arista actively induced infringement of claim 6 of the '930 Patent by instructing others to use power sourcing equipment (data nodes) (made by Arista or others), combined with and connected to powered devices (access devices) (made by Arista or others), as suggested by Arista's manuals, advertising, place cards, instructions, and other literature, to practice the method of claim 6 for remotely powering access equipment in a data network, that satisfies all of the claimed elements as described below.

Arista's products were designed and functioned consistent with the IEEE 802.3af [2] or 802.3at [3] Standards. [4] Sample statements demonstrating that the Arista's products conform to the IEEE 802.3af or 802.3at Standards include:

- "10M-1G UTP (30W 802.3af/at)"
- "Selected Arista switches provide power over Ethernet (PoE) to power connected devices. Arista's PoE implementation is compliant with IEEE standards 802.3af and 802.3at, and includes partial support for 802.3bt."
- "Standard Compliance • 802.3af/at 15W/30W Power over Ethernet (PoE)"

Claim language	**Evidence and Analysis [5]**
Claim 6	
Pre: Method for remotely powering access equipment in a data network, comprising	*Sample evidence (Arista statements, depictions, and other documentation), includes*: [6] • *See* elements [a] – [d] below; • "Selected Arista switches provide power over Ethernet (PoE) to power connected devices." *802.3af, 802.3at, and 802.3-2008 Standards statements and depictions includes*: • "Abstract: Support for optionally powering a 10BASE-T, 100BASE-TX or 1000BASE-T DTE device via the Power Interface (PI) using physical layers

[2] The IEEE 802.3af Standard extends prior 802.3 Ethernet standards to support devices and interfaces for remotely powering access equipment in a data network. (IEEE 802.3af Standard).

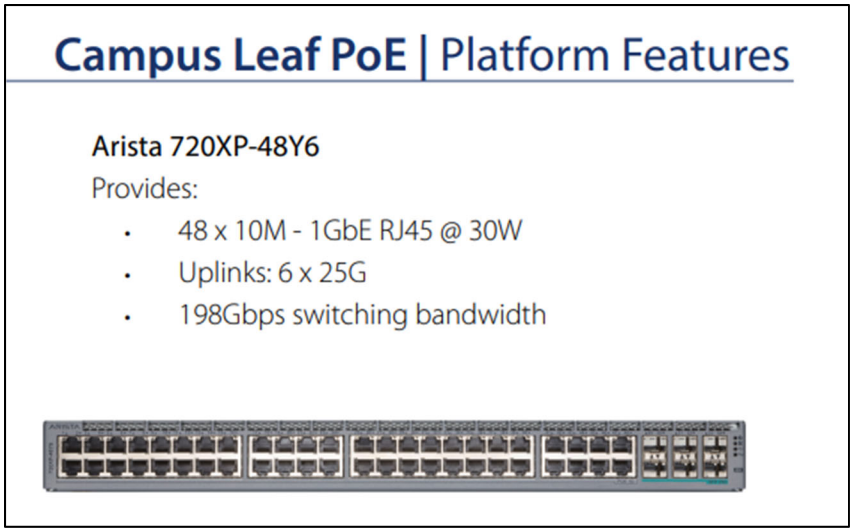
[3] "Abstract: This amendment includes changes to IEEE Std 802.3-2008 to augment the capabilities of IEEE Std 802.3 with higher power levels and improved power management information." (IEEE 802.3at Standard Abstract).

[4] All components of the 802.3af Standard are integrated into 802.3-2008 Standard.

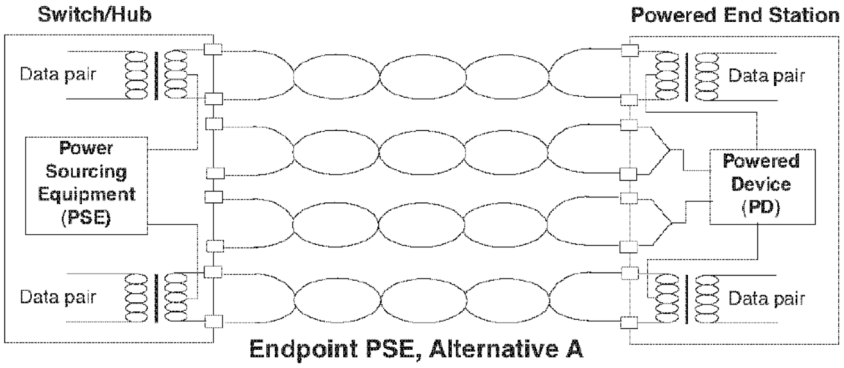
[5] This infringement chart is exemplary and does not present all infringement theories, including any doctrine of equivalents theories.

[6] The "*Sample evidence (Arista statements, depictions, and other documentation)*" are illustrative examples of statements, depictions, and other documentation that help one understand and put into context the evidence for each claim element.

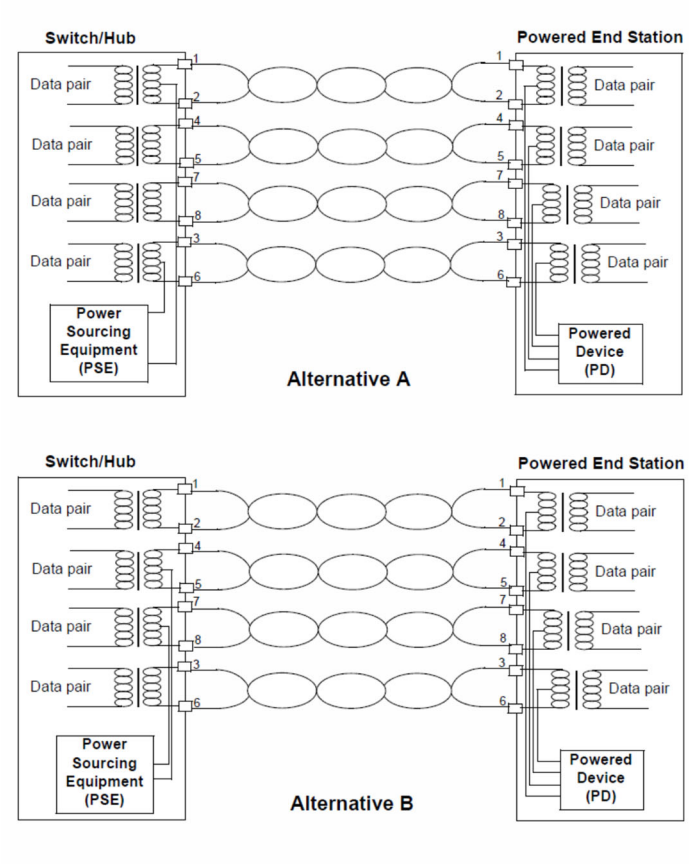
	defined in Clauses 14, 25, and 40. The Power Sourcing Equipment (PSE) is located at an endpoint or midspan, separate from and between the MDIs, and provides power to the Powered Device (PD) over the Link Section." (IEEE 802.3af Standard Abstract); • "DTE powering is intended to provide a single 10BASE-T, 100BASE-TX, or 1000BASE-T device with a unified interface for both the data it requires and the power to process these data." (IEEE 802.3af Standard Definition 1.4x (PSE)); • "DTE powering is intended to provide a 10BASE-T, 100BASE-TX, or 1000BASE-T device with a single interface to both the data it requires and the power to process this data." (IEEE 802.3af Standard 33.1); (IEEE 802.3at Standard 33.1). The IEEE 802.3af and IEEE 802.3at Standards extend prior 802.3 Ethernet standards to support methods and interfaces for remotely powering access equipment (*i.e.*, powered devices) in a data network, *e.g.*, 10BASE-T, 100BASE-TX, or 1000BASE-T networks. *Identification*: The preamble is a method for (a) "remotely powering access equipment," (b) "in a data network." • (a) remotely powering access equipment: Power sourcing equipment (data nodes, addressed below), made by Arista or others, combined with powered devices (access devices, addressed below), made by Arista or others, are used to practice a method for remotely powering access equipment (the powered devices, access devices) as addressed in elements [a] through [d] below. The "access equipment" is the powered devices (access devices) that access data and power through a network. Examples of such access equipment include (a) phones (*e.g.*, IP phones), (b) wireless access points, and (c) cameras.

	• (b) <u>in a data network</u>: The "data network" refers to the Ethernet network that transmits data and power between power sourcing equipment (data nodes) and powered devices (access devices).
[a-1] providing a data node adapted for data switching	*<u>Sample evidence (Arista statements, depictions, and other documentation) includes</u>*:  • "The Arista Cognitive Campus 720XP series switches deliver connectivity and power for all campus user workloads, under the management and monitoring of Arista Cognitive Campus Services." • "Campus Leaf PoE 10M/100G Switches." • "The 720XP series switches utilizes data center class virtualization features to provide hundreds of segmented networks to thousands of users and devices." *<u>802.3af, 802.3at, and 802.3-2008 Standards statements and depictions include</u>*: • "Power sourcing equipment. PSE, as the name implies, is the equipment that provides the power to a single link section. The PSE's main functions are to search the link section for a PD, optionally classify the PD, supply power to the link section (only if a PD is detected), monitor the power on the link section, and scale power back to the detect level when power is no

longer requested or required." (IEEE 802.3af Standard 33.2); (IEEE 802.3-2008 Standard 33.2);



(IEEE 802.3af Standard Figure 33-4); (IEEE802.3-2008 Standard Figure 33-4); (IEEE 802.3at Standard Figure 33-4);



(IEEE 802.3at Standard Figure 33-5);

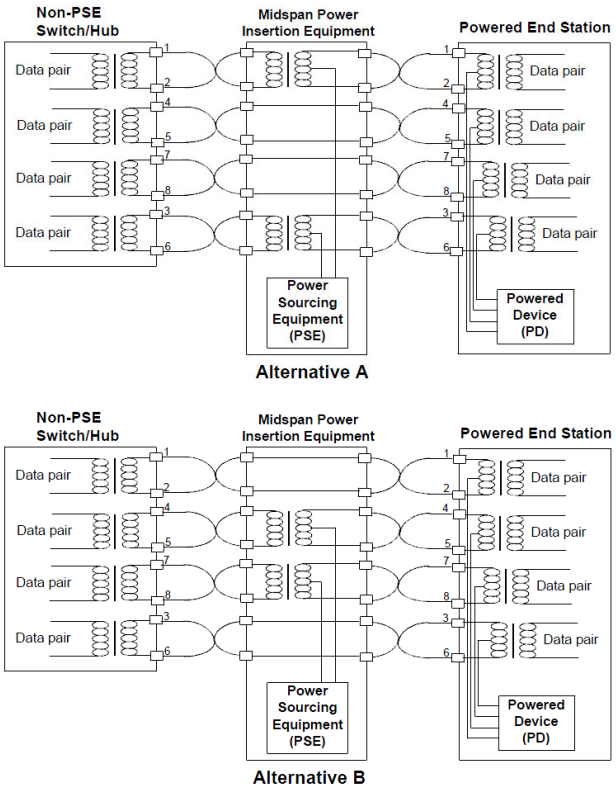


Figure 33–7—1000BASE-T Midspan PSE location overview

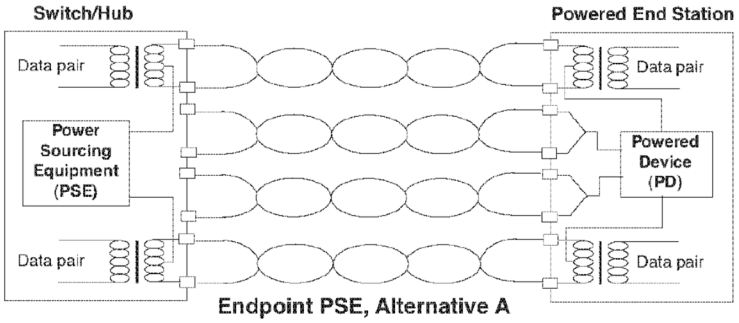
(IEEE 802.3at Standard Figure 33-7);

- "The PSE is the portion of the end station or midspan equipment that provides the power to a single PD. The PSE's main functions are as follows: — To search the link section for a PD — To supply power to the detected PD through the link section — To monitor the power on the link section — To remove power when no longer requested or required, returning to the searching state." (IEEE 802.3at Standard 33.2).

Under the IEEE 802.3af and 802.3at standards, Arista's switches are Endpoint PSEs (power sourcing equipment) which are data nodes adapted for switching.

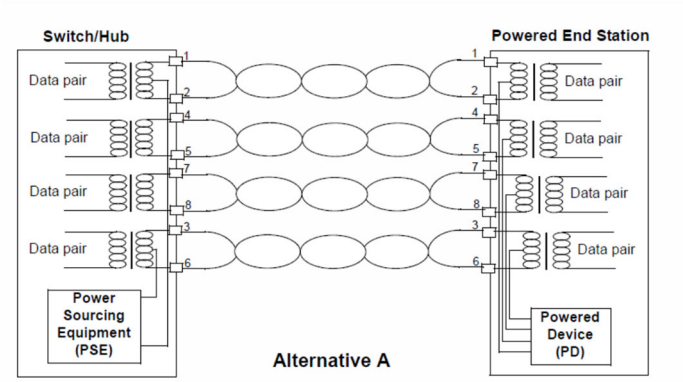
	Identification: The "data node adapted for data switching" is each Arista Power over Ethernet switch or hub, and each Power over Ethernet switch or hub made by others used in connection with Arista's powered devices (access devices). Arista's Power over Ethernet switches or hubs, and the switches or hubs made by others, have multiple ports (*e.g.*, 8-ports, 24-ports) and can switch data between ports, providing switching functionality.
[a-2] an access device adapted for data transmission	*Sample evidence (Arista statements, depictions, and other documentation) includes*:  Arista C-100 • [C-100 Dual radio 2x2:2 MU-MIMO 802.11ac Wave 2 access point] • "Peak Data Rages Up to 867 Mbps" [C-100 Dual radio 2x2:2 MU-MIMO 802.11ac Wave 2 access point] • "Third party analytics integration for real-time data transfer." [C-100 Dual radio 2x2:2 MU-MIMO 802.11ac Wave 2 access point] • "Selected Arista switches provide power over Ethernet (PoE) to power connected devices."

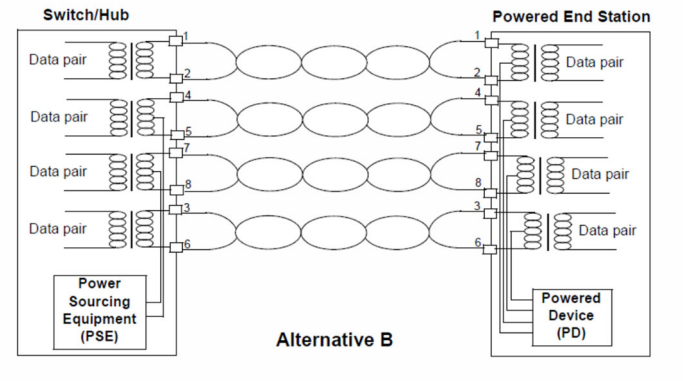
802.3af, 802.3at, and 802.3-2008 Standards statements and depictions include:



(IEEE 802.3af Standard Figure 33-4);

(IEEE802.3-2008 Standard Figure 33-4); (IEEE 802.3at Standard Figure 33-4);





(IEEE 802.3at Standard Figure 33-5);

- "A PD designed to the standard, and within its range of available power, can obtain both power and data for operation through the MDI and therefore need

	no additional connections." (IEEE 802.3af Standard 33.1.1); (IEEE 802.3-2008 Standard 33.1.1); (IEEE 802.3at Standard 33.1.1). The Arista power sourcing equipment (data nodes) are specifically designed for use with IEEE 802.3af and IEEE 802.3at compliant powered devices (access devices). The Arista powered devices (access devices) are 802.3af and 802.3at compliant powered devices (access devices). Under the 802.3af and 802.3at Standards, the Powered End Station—powered device (PD) is an access device adapted for data transmission. *Identification*: The "access device adapted for data transmission" is each of the powered devices (access devices) made by Arista or others, that are used in conjunction with the power sourcing equipment (data nodes, addressed above) made by Arista or others, that can receive and transmit data. Non-limiting examples of such access devices include (a) phones (including IP phones), (b) wireless access points, and (c) cameras (*e.g.*, security cameras).
[a-3] at least one data signaling pair connected between the data node and the access device and arranged to transmit data therebetween	*Sample evidence (Arista statements, depictions, and other documentation) includes*: • "Category 5 cabling." • "Gigabit Ethernet physical layer standards that Arista switches support include 1000BASE-X (optical fiber), 1000BASE-T (twisted pair cable)" *802.3af, 802.3at, and 802.3-2008 Standards statements and depictions include*:

Table 33–1—PSE pinout alternatives

Conductor	Alternative A (MDI-X)	Alternative A (MDI)	Alternative B (All)
1	Negative V_{Port}	Positive V_{Port}	
2	Negative V_{Port}	Positive V_{Port}	
3	Positive V_{Port}	Negative V_{Port}	
4			Positive V_{Port}
5			Positive V_{Port}
6	Positive V_{Port}	Negative V_{Port}	
7			Negative V_{Port}
8			Negative V_{Port}

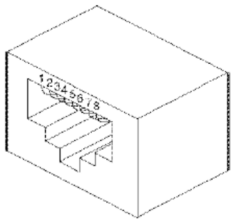
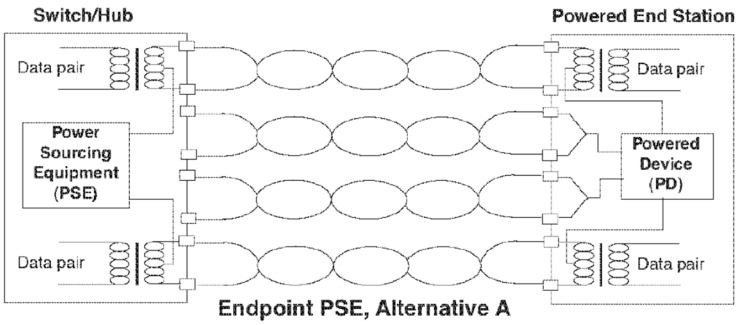
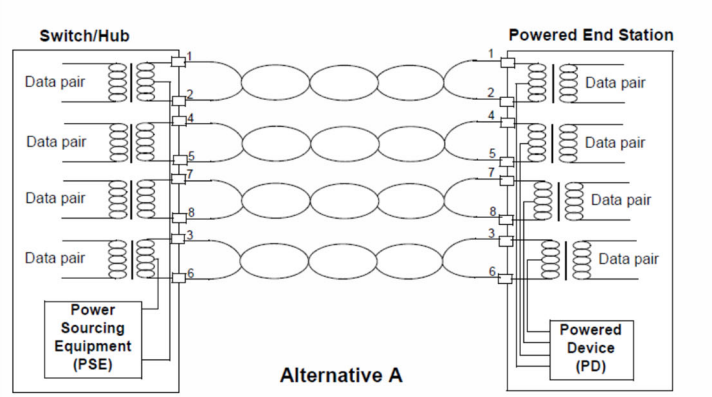


Figure 33–5—PD and PSE eight-pin modular jack

(IEEE 802.3af Standard Table 33-1 and Figure 33-5); (IEEE 802.3-2008 Standard Table 33-1 and Figure 33-5); (IEEE 802.3at Standard Table 33-2 and Figure 33-8);



(IEEE 802.3af Standard Figure 33-4);



(IEEE 802.3at Standard Figure 33-5);

- "PI pin assignments. A PSE device may provide power via one of two valid four-wire connections. In each four-wire connection, the two conductors associated with a pair each carry the same nominal current in both magnitude and polarity. For the purposes of data transfer, the type of PSE data port is relevant to the far-end PD and in some cases to the cabling system between them." (IEEE 802.3af Standard 33.2.2); (IEEE 802.3-2008 Standard 33.2.2); (IEEE 802.3at Standard 33.2.3).

Arista's power sourcing equipment (data nodes) are designed to be connected to IEEE 802.3af and IEEE 802.3at compliant access devices via a cable with at least one data signaling pair (*e.g.*, a Category 5 cable). The data signaling pair is defined as the twisted pair medium that connects the medium dependent interface (MDI) on the PSE to the MDI on the PD. As the 802.3af Standard was designed for 10Base-T, 100Base-

	TX, and 1000Base-T, this is 2 pair or greater Category 3, 4, 5, 5e or better cable designed and installed for data transmission. Under the 802.3af and 802.3at Standards, the interface of the data signaling pair is referred to as the twisted pair medium dependent interface that connects to the line transformer data pairs as shown in Figure 33-4 of the standards. Table 33-1 details the particular pins that may be used by the data pairs. *Identification*: The "at least one data signaling pair connected between the data node and the access device and arranged to transmit data therebetween" is a pair of wires in an Ethernet cable arranged to connect and transmit data and power between data nodes (addressed above) and access devices (addressed above). A non-limiting example of such a data signaling pair is a pair of twisted wires found in a Category 5 (CAT-5) Ethernet cable used to transmit data and power. In this example, a data signaling pair can be the pair of wires that connect pins 1 and 2 of the RJ-45 connector of the power sourcing equipment (data node) to the corresponding pins of the powered device (access device).
[a-4] a main power source connected to supply power to the data node, and	*Sample evidence (Arista statements, depictions, and other documentation) includes*: • "The 750 Series leverages a set of high efficiency 3.3kW power supplies for both system power and PoE power." [750 Series Campus Switches 8-Slot and 5-Slot Modular Datasheet]. • "With as few as two power supplies the system is redundant." [750 Series Campus Switches 8-Slot and 5-Slot Modular Datasheet.]

Arista 750 Series Power Supply
(AC 3.3kW, front to rear)

- 750 Series Campus Switches 8-Slot and 5-Slot Modular Datasheet.
- "Power supplies and Fans Campus CCS-720 series switches support N+1 redundant power supplies. The 720XP 24/48 port switches ship with one or two power supply by default, and the second power supply can be purchased when the switch is ordered or at a later time. If only one power supply is installed, it should always be in power supply bay #1." [CCS-720 Campus Switches Data Sheet].

802.3af, 802.3at, and 802.3-2008 Standards statements and depictions include:

- "PSE, as the name implies, is the equipment that provides the power to a single link section." (IEEE 802.3af Standard 33.2); (IEEE 802.3-2008 Standard 33.2);
- "The PSE is the portion of the end station or midspan equipment that provides the power to a single PD." (IEEE 802.3at Standard).

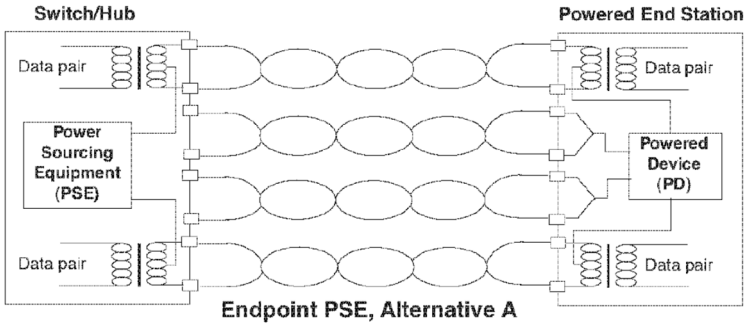
Arista's IEEE 802.3af and IEEE 802.3at compliant power sourcing equipment, which needs power to function, is powered by a main power source. The IEEE 802.3af and IEEE 802.3at Standards do not specify particular requirements for the main power source, but such a main power source is necessary for the power sourcing equipment (PSE) to function.

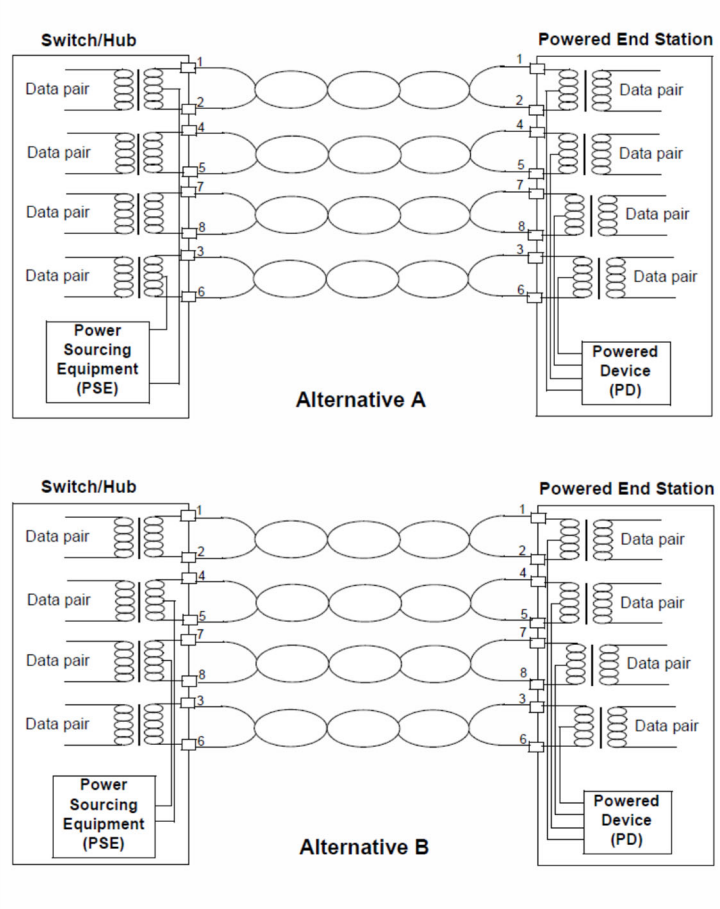
	Identification: The Federal Circuit construed "main power source" broadly as any source of power, including "both AC and DC power sources." *Network-1 Techs. v. Hewlett-Packard Co.*, 976 F.3d 1301, 1310 (Fed. Cir. 2020). Arista's power sourcing equipment (data nodes), and the power sourcing equipment (data nodes) made by others used in connection with Arista's powered devices (access devices), have access to "a main power source connected to supply power to the data node." There are three identifications under which the "main power source" is connected, via electrical connections, wiring, or cables, to supply certain power requirements to at least certain electrical components of the data nodes: • Identification 1: The "main power source" that supplies power to the power sourcing equipment (data nodes, addressed above) is a DC power supply [7] that provides DC power to components of the data node. A non-limiting example of such a DC power supply is a power supply that provides 12V and 48V outputs to power components of the data node. • Identification 2: The "main power source" is a combination of power supplies, arranged in series or parallel, that provide DC power to components of the data node. As a non-limiting example, the combination of power supplies can consist of (1) a power supply that provides a 12V output to power some components of the data node, and (2) a power supply that provides a 48V output to power other components of the data node. The "main power source" can be, or be connected to receive power from, a power rack. • Identification 3: The "main power source" is an AC power source provided via a power cord that is adapted to connect an AC outlet to the power

[7] A power supply is a collection of electronic circuitry or components used to convert voltages and currents.

	sourcing equipment (data nodes). The connection can be established by, for example, plugging one end of the power cord into a dedicated grounded AC outlet or power strip and the other end into the AC power socket of the data node. [8]
[a-5] a secondary power source arranged to supply power from the data node via said data signaling pair to the access device,	*Sample evidence (Arista statements, depictions, and other documentation) includes*: • "The 750 Series leverages a set of high efficiency 3.3kW power supplies for both system power and PoE power." 750 Series Campus Switches 8-Slot and 5-Slot Modular Datasheet. • "With as few as two power supplies the system is redundant." 750 Series Campus Switches 8-Slot and 5-Slot Modular Datasheet.  *Arista 750 Series Power Supply (AC 3.3kW, front to rear)* • 750 Series Campus Switches 8-Slot and 5-Slot Modular Datasheet. • "Power supplies and Fans Campus CCS-720 series switches support N+1 redundant power supplies. The 720XP 24/48 port switches ship with one or two power supply by default, and the second power supply can be purchased when the switch is ordered or at a later time. If only

[8] For example, switches and routers (data nodes) are often sold with a power cord adapted for connection to an AC outlet, either directly or using an external power supply, connected to supply main power to the switches and routers (and to semiconductor logic circuits within the switch).

	one power supply is installed, it should always be in power supply bay #1." [CCS-720 Campus Switches Data Sheet]. • "Selected Arista switches provide power over Ethernet (PoE) to power connected devices. Arista's PoE implementation is compliant with IEEE standards 802.3af and 802.3at, and includes partial support for 802.3bt." • "Selected Arista switches provide power over Ethernet (PoE) to power connected devices." *802.3af, 802.3at, and 802.3-2008 Standards statements and depictions include*:  (IEEE 802.3af Standard Figure 33-4); (IEEE 802.3-2008 Standard Figure 33-4); (IEEE 802.3at Standard Figure 33-4);



(IEEE 802.3at Standard Figure 33-5);

- "DTE powering is intended to provide a 10BASE-T, 100BASE-TX, or 1000BASE –T devices with a single interface to both the data it requires and the power to process this data. This clause specifies the following a) A power source to add power to the 100 Ω balanced cabling system." (IEEE 802.3-2008 Standard 33.1); (IEEE 802.at Standard 33.1.1).
- "33.2.8.4 Maximum output current in normal powering mode at PSE min output voltage. For V_{Port} > 44V, the minimum value for I_{Port_max} in Table 33–5 shall be 15.4W/VPort. The current I_{Port_max} ensures 15.4W min output power." (IEEE 802.3af Standard 33.2.8.4); (IEEE 802.3-2008 Standard 33.2.8.4);
- "33.2.8.1 Output voltage. The specification for V_{Port} in Table 33–5 shall include line and temperature variations. The voltage potential

shall be measured between any conductor of one power pair and any conductor of the other power pair." (IEEE 802.3af Standard 33.2.8.1); (IEEE 802.3-2008 Standard 33.2.8.1);

Table 33–11—PSE output PI electrical requirements for all PD classes, unless otherwise specified *(continued)*

Item	Parameter	Symbol	Unit	Min	Max	PSE Type	Additional information
14	Turn on rise time	T_{Rise}	µs	15.0		1, 2	From 10 % to 90 % of the voltage difference at the PI in POWER_ON state from the beginning of POWER_UP.
15	Turn off time	T_{Off}	s		0.500	1, 2	See 33.2.7.8.
16	Turn off voltage	V_{Off}	V		2.80	1, 2	See 33.2.7.9.
17	DC MPS current	I_{Hold}	A	0.005	0.010	1, 2	See 33.2.9.1.2.
18	PD Maintain Power Signature dropout time limit	T_{MPDO}	s	0.300	0.400	1, 2	See 33.2.9.
19	PD Maintain Power Signature time for validity	T_{MPS}	s	0.060		1, 2	See 33.2.9.
20	Current unbalance	I_{unb}	A		3 % × I_{Cable}	1	See 33.2.7.11, 33.4.8. NOTE—For practical implementations, it is recommended that Type 1 PSEs support Type 2 I_{unb} requirements.
					3 % × I_{Peak}	2	
21	Alternative B detection backoff time	T_{dbo}	s	2.00		1, 2	
22	Output capacitance during detection state	C_{out}	µF		0.520	1, 2	
23	Detection timing	T_{det}	s		0.500	1, 2	Time to complete detection of a PD.
24	Error delay timing	T_{ed}	s	0.750		1, 2	Delay before PSE may attempt subsequent powering after power removal because of error condition.

Table 33–11—PSE output PI electrical requirements for all PD classes, unless otherwise specified

Item	Parameter	Symbol	Unit	Min	Max	PSE Type	Additional information
1	Output voltage in the POWER_ON state	V_{Port_PSE}	V	44.0	57.0	1	See 33.2.7.1.
				50.0	57.0	2	
2	Voltage transient below V_{Port_PSE} min	K_{Tran_lo}	%		7.6	2	See 33.2.7.2.
3	Power feeding ripple and noise:						
	f < 500 Hz		V_{pp}		0.500	1, 2	See 33.2.7.3.
	500 Hz to 150 kHz				0.200		
	150 kHz to 500 kHz				0.150		
	500 kHz to 1 MHz				0.100		
4	Continuous output current capability in POWER_ON state	I_{Con}	A	P_{Class} / V_{Port_PSE}		1, 2	See 33.2.7.4.
5	Output current in POWER_UP state	I_{Inrush}	A	0.400	See info	1, 2	See 33.2.7.5. Max value defined by Figure 33–13.
6	Inrush time	T_{Inrush}	s	0.050	0.075	1, 2	See 33.2.7.5
7	Overload current detection range	I_{CUT}	A	P_{Class} / V_{Port_PSE}	I_{LIM}	1,2	Optional limit; see 33.2.7.6, Table 33–7.
8	Overload time limit	T_{CUT}	s	0.050	0.075	1, 2	See 33.2.7.7
9	Output current – at short circuit condition	I_{LIM}	A	0.400	See info	1	See 33.2.7.7. Max value defined by Figure 33–14.
				1.14 × I_{Cable}		2	
10	Short circuit time limit	T_{LIM}	s	0.050	See info	1	See 33.2.7.7.
				0.010		2	
11	Continuous output power capability in POWER_ON state	P_{Con}	W	P_{Class}		1, 2	See 33.2.7.10, Table 33–7.
12	PSE Type power minimum	P_{Type}	W	I_{Cable} × (V_{Port_PSE} min)		1, 2	See 33.1.4.
13	Power turn on time	T_{pon}	s		0.400	1, 2	See 33.2.7.12.

(IEEE 802.3at Standard Table 33-11);

	• "When the PSE provides power to the PI, it shall conform with Table 33-11." (IEEE 802.3at at 33.2.7). Arista's IEEE 802.3af and IEEE 802.at compliant power sourcing equipment have a source of secondary power which provides operating power from the Switch/Hub (the Power Sourcing Equipment (PSE)) to the Powered End Station (Powered Device (PD)). *Identification*: Arista's power sourcing equipment (data nodes, addressed above), and the power sourcing equipment (data nodes) made by others used in connection with Arista's powered devices (access devices), use "a secondary power source arranged to supply power from the data node via said data signaling pair to the access device." When a properly configured powered device (access device, addressed above) is detected, the secondary power source supplies power (for example (non-limiting), 48 Volts DC for an access device that requires such a power load) from the power sourcing equipment (data node, addressed above) through the data signaling pairs (addressed above, *e.g.*, Ethernet Category 5 cables) to the powered device (access device) to supply operating power to the powered device (access device). The power sourcing equipment (data nodes) incorporate a control valve or switch (which may be part of an integrated circuit) that controls the application of power to the access device derived from the main power source (addressed above). The control valve or switch (for example (non-limiting), a MOSFET switch or other transistor) is electrically located between the main power source and the access device, and is a downstream or separate driving point from the main power source, for the function of providing operating power to the powered device (access device).

[b] delivering a low level current from said main power source to the access device over said data signaling pair,	*Sample evidence (Arista statements, depictions, and other documentation) includes*: • "When a standards-compliant powered device (PD) is connected to a PoE-enabled Ethernet port, it is recognized by a specific resistor signature, and its power class is determined by hardware negotiation" *802.3af, 802.3at, and 802.3-2008 Standards statements and depictions include:* • "The PSE probes the link section in order to detect a valid PD detection signature." (IEEE 802.3af Standard 33.2.6); (IEEE 802.3-2008 Standard 33.2.6); • "The PSE shall detect the PD by probing via the PSE PI." (IEEE 802.3af Standard 33.2.5); (IEEE 802.3-2008 Standard 33.2.5); • "The detection voltage V_{detect} shall be within the V_{Valid} voltage range at the PSE PI as specified in Table 33–2 with a valid PD detection signature connected." (IEEE 802.3af Standard 33.2.5.1); (IEEE 802.3-2008 Standard 33.2.5.1);

Item	Parameter	Symbol	Unit	Min	Max	Additional information
1	Open circuit voltage	V_{oc}	V		30	In detection mode only
2	Short circuit current	I_{sc}	mA		5	In detection mode only
3	Valid test voltage	V_{valid}	V	2.8	10	

Table 33–2—PSE PI detection mode electrical requirements *(continued)*

Item	Parameter	Symbol	Unit	Min	Max	Additional information
4	Voltage difference between test points	ΔV_{test}	V	1		
5	Time between any two test points	T_{BP}	ms	2		This timing implies a 500Hz maximum probing frequency.
6	Slew rate	V_{slew}	V/µs		0.1	
7	Accept signature resistance	R_{good}	KΩ	19	26.5	
8	Reject signature resistance	R_{bad}	KΩ	15	33	
9	Open circuit resistance	R_{open}	KΩ	500		
10	Accept signature capacitance	C_{good}	nF		150	
11	Reject signature capacitance	C_{bad}	µF	10		
12	Signature offset voltage tolerance	V_{os}	V	0	2.0	See Annex 33A for examples of valid signatures.
13	Signature offset current tolerance	I_{os}	µA	0	12	

(IEEE 802.3af Standard Table 33-2);

(IEEE 802.3-2008 Standard Table 33-2);

Table 33–4—PSE PI detection state electrical requirements

Item	Parameter	Symbol	Unit	Min	Max	Additional information
1	Open circuit voltage	V_{oc}	V		30.0	In detection state only
2	Short circuit current	I_{sc}	A		0.005	In detection state only
3	Valid test voltage	V_{valid}	V	2.80	10.0	—
4	Voltage difference between test points	ΔV_{test}	V	1.00		—
5	Slew rate	V_{slew}	V/µs		0.100	—

(IEEE 802.3at Standard Table 33-4);

- "The PSE probes the link section in order to detect a valid PD detection signature. The PSE PI is connected to a PD through a link segment." (IEEE 802.3at Standard 33.2.);

	• "The detection voltage at the PSE PI shall be within the V_{valid} voltage range (as specified in Table 33-4) with a valid PD detection signature connected (as specified in Table 33-14)." (IEEE 802.3at Standard 33.2.5.2); • "The open circuit voltage and short circuit current shall meet the specifications in Table 33–2." (IEEE 802.3af Standard 33.2.5). Arista's IEEE 802.3af and IEEE 802.3at compliant power sourcing equipment contains circuitry that delivers a low level current (detection probe) to the access device over the data signaling pairs via a PD detection signature. *Identification*: The Federal Circuit construed "low level current" as "a non-data-signal current that is sufficient to begin start up of the access device but that is not sufficient to sustain the start up." *Network-1 Techs. v. Hewlett-Packard Co.*, 976 F.3d 1301, 1309 (Fed. Cir. 2020). The low level current delivered from the main power source (addressed above) to the access device (powered device, addressed above) over the data signaling pair (addressed above) is the detection current (for example (non-limiting), in the range of 10 to 500 micro amps), that is used (as opposed to a data signal) to determine whether the access device (powered device) can receive operating power.
[c] sensing a voltage level on the data signaling pair in response to the low level current	*Sample evidence (Arista statements, depictions, and other documentation) include*: • "When a standards-compliant powered device (PD) is connected to a PoE-enabled Ethernet port, it is recognized by a specific resistor signature, and its power class is determined by hardware negotiation" • "Power over Ethernet (PoE) is enabled by default on all Ethernet ports of PoE-capable switches, and the switch will detect IEEE-compliant powered devices (PDs) when they are plugged into a port and supply power appropriately."

802.3af, 802.3at, and 802.3-2008 Standards statements and depictions include:

Item	Parameter	Symbol	Unit	Min	Max	Additional information
1	Open circuit voltage	V_{oc}	V		30	In detection mode only
2	Short circuit current	I_{sc}	mA		5	In detection mode only
3	Valid test voltage	V_{valid}	V	2.8	10	

(IEEE 802.3af Standard Table 33-2);

(IEEE 802.3-2008 Standard Table 33-2);

Table 33–2—PSE PI detection mode electrical requirements *(continued)*

Item	Parameter	Symbol	Unit	Min	Max	Additional information
4	Voltage difference between test points	ΔV_{test}	V	1		
5	Time between any two test points	T_{BP}	ms	2		This timing implies a 500Hz maximum probing frequency.
6	Slew rate	V_{slew}	V/µs		0.1	
7	Accept signature resistance	R_{good}	KΩ	19	26.5	
8	Reject signature resistance	R_{bad}	KΩ	15	33	
9	Open circuit resistance	R_{open}	KΩ	500		
10	Accept signature capacitance	C_{good}	nF		150	
11	Reject signature capacitance	C_{bad}	µF	10		
12	Signature offset voltage tolerance	V_{os}	V	0	2.0	See Annex 33A for examples of valid signatures.
13	Signature offset current tolerance	I_{os}	µA	0	12	

- "33.2.5.1 Detection probe requirements. The detection voltage V_{detect} shall be within the V_{valid} voltage range at the PSE PI as specified in Table 33-2 with a valid PD detection signature connected. The PSE shall make at least two measurements with V_{detect} values that create at least a ΔV_{test} difference as specified in Table 33-2 between the two measurements with a valid PD detection signature connected." (IEEE 802.3af Standard 33.5.1); (IEEE 802.3-2008 Standard 33.2.5.1);

Table 33–5—Valid PD detection signature electrical characteristics

Item	Parameter	Symbol	Unit	Min	Max	Additional information
1	Accept signature resistance	R_{good}	kΩ	19.0	26.5	—
2	Accept signature capacitance	C_{good}	µF		0.150	—
3	Signature offset voltage tolerance	V_{os}	V	0	2.00	—
4	Signature offset current tolerance	I_{os}	µA	0	12.0	—

(IEEE 802.3at Standard Table 33-5);

- "The detection voltage at the PSE PI shall be within the V_{valid} voltage range (as specified in Table 33-4) with a valid PD detection signature connected (as specified in Table 33-14). In evaluating the presence of a valid PD, the PSE shall make at least two measurements with V_{PSE} values that create at least a ΔV_{test} difference as specified in Table 33-4. An effective resistance is calculated from two voltage/current measurements made during the detection process." (IEEE 802.3at Standard 33.2.5.2).

Arista's IEEE 802.3af and 802.3at compliant power sourcing equipment contain circuitry that senses a resulting voltage (detection signature) once a powered device (access devices) has been detected on the data signaling pair.

Identification: Arista's power sourcing equipment (data nodes, addressed above), and the power sourcing equipment of others used in connection with Arista's powered devices (access devices), includes an integrated circuit that contains circuitry that senses a voltage level or current level on the data signaling pair (addressed above), *e.g.*, the signature of the powered device (access device), in response to the low level current (addressed above) delivered on (or applied to) the data signaling pair.

[d] controlling power supplied by said secondary power source to said access device in response to a preselected condition of said voltage level.	*Sample evidence (Arista statements, depictions, and other documentation) include*: • "When a standards-compliant powered device (PD) is connected to a PoE-enabled Ethernet port, it is recognized by a specific resistor signature, and its power class is determined by hardware negotiation" • "Power over Ethernet (PoE) is enabled by default on all Ethernet ports of PoE-capable switches, and the switch will detect IEEE-compliant powered devices (PDs) when they are plugged into a port and supply power appropriately." *802.3af, 802.3at, and 802.3-2008 Standards statements and depictions include:* • "In an operation mode, the PSE shall not apply operating power to the PI until the PSE has successfully detected a PD requesting power" (IEEE 802.3-2008 Standard 33.2.4); • "33.2.5.1 Detection probe requirements. The detection voltage V_{detect} shall be within the V_{valid} voltage range at the PSE PI as specified in Table 33-2 with a valid PD detection signature connected. The PSE shall make at least two measurements with V_{detect} values that create at least a ΔV_{test} difference as specified in Table 33-2 between the two measurements with a valid PD detection signature connected." (IEEE 802.3af Standard 33.5.1); (IEEE 802.3-2008 Standard 33.2.5.1);

Item	Parameter	Symbol	Unit	Min	Max	Additional information
1	Open circuit voltage	V_{oc}	V		30	In detection mode only
2	Short circuit current	I_{sc}	mA		5	In detection mode only
3	Valid test voltage	V_{valid}	V	2.8	10	

Table 33–2—PSE PI detection mode electrical requirements *(continued)*

Item	Parameter	Symbol	Unit	Min	Max	Additional information
4	Voltage difference between test points	ΔV_{test}	V	1		
5	Time between any two test points	T_{BP}	ms	2		This timing implies a 500Hz maximum probing frequency.
6	Slew rate	V_{slew}	V/µs		0.1	
7	Accept signature resistance	R_{good}	KΩ	19	26.5	
8	Reject signature resistance	R_{bad}	KΩ	15	33	
9	Open circuit resistance	R_{open}	KΩ	500		
10	Accept signature capacitance	C_{good}	nF		150	
11	Reject signature capacitance	C_{bad}	µF	10		
12	Signature offset voltage tolerance	V_{os}	V	0	2.0	See Annex 33A for examples of valid signatures.
13	Signature offset current tolerance	I_{os}	µA	0	12	

(IEEE 802.3af Standard Table 33-2);

(IEEE 802.3-2008 Standard Table 33-2);

- "The detection voltage at the PSE PI shall be within the V_{valid} voltage range (as specified in Table 33-4) with a valid PD detection signature connected (as specified in Table 33-14). In evaluating the presence of a valid PD, the PSE shall make at least two measurements with V_{PSE} values that create at least a ΔV_{test} difference as specified in Table 33-4. An effective resistance is calculated from two voltage/current measurements made during the detection process." (IEEE 802.3at Standard 33.2.5.2);
- "A PSE shall accept as a valid signature a link section with both of the following characteristics between the powering pairs with an offset voltage up to V_{os} max and an offset current up to I_{os} max, as specified in Table 33-5: a) Signature resistant R_{good}, and b) Parallel signature capacitance C_{good}." (IEEE 802.3at Standard, 33.2.5.2);

- "A PSE shall accept as a valid signature a link section with both of the following characteristics between the powering pairs with an offset voltage up to V_{os} max and an offset current up to I max, as specified in Table 33–2: a) Signature resistance R_{good}, and b) Parallel signature capacitance C_{good}." (IEEE 802.3-2008 Standard 33.2.6.1);

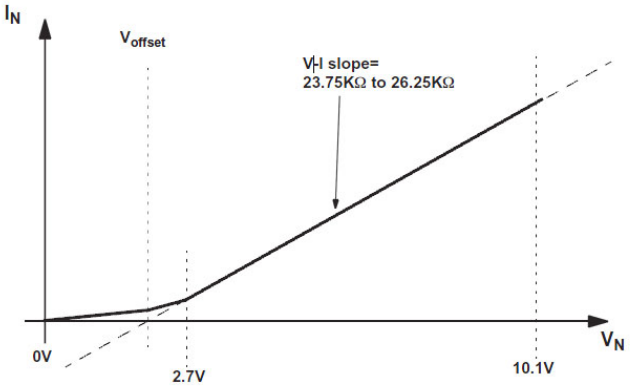


Figure 33C.20—Signature voltage offset

(IEEE 802.3af Standard 33C.20);

(IEEE 802.3-2008 Standard 33C-20);

- "33.2.8.4 Maximum output current in normal powering mode at PSE min output voltage. For V_{Port} > 44V, the minimum value for I_{Port_max} in Table 33–5 shall be 15.4W/V_{Port}. The current I_{Port_max} ensures 15.4W min output power." (IEEE 802.3af Standard 33.2.8.4);
- "33.2.8.1 Output voltage. The specification for V_{Port} in Table 33–5 shall include line and temperature variations. The voltage potential shall be measured between any conductor of one power pair and any conductor of the other power pair." (IEEE 802.3af Standard 33.2.8.1);
- "When the PSE provides power to the PI, it shall conform with Table 33–5, Figure 33–6, and Figure 33–7." (IEEE 802.3-2008 Standard 33.2.8);

Table 33–5—PSE output PI electrical requirements for all PD classes, unless otherwise specified

Item	Parameter	Symbol	Unit	Min	Max	Additional information
1	Output voltage	V_{Port}	Vdc	44	57	See 33.2.8.1
2	Load regulation		V	44	57	See 33.2.8.2
3	Power feeding ripple and noise:					
	f < 500 Hz		V_{pp}		0.5	See 33.2.8.3
	500 Hz to 150 kHz		V_{pp}		0.2	
	150 kHz to 500 kHz		V_{pp}		0.15	
	500 kHz to 1 MHz		V_{pp}		0.1	
4	Maximum output current in normal powering mode at PSE min output voltage	I_{Port_max}	mAdc	350		See 33.2.8.4
5	Output current in startup mode	I_{Inrush}	mA	400	450	See 33.2.8.5
6	a) IDLE state current 1	I_{Min1}	mA	0	5	Relevant for 33.2.10.1.2. PSE removes power for $t > T_{MPDO}$
	b) IDLE state current 2	I_{Min2}	mA	5	10	Relevant for 33.2.10.1.2. PSE may or may not remove power for $t > T_{MPDO}$
7a	PD Maintain Power Signature dropout time limit	T_{MPDO}	ms	300	400	See 33.2.10
7b	PD Maintain Power Signature time for validity	T_{MPS}	ms	60		See 33.2.10
8	Overload current detection range	I_{CUT}	mA	15400/ V_{Port}	400	See 33.2.8.6
9	Overload time limit	T_{ovld}	ms	50	75	See 33.2.8.7
10	Output current – at short circuit condition	I_{LIM}	mA	400	450	See 33.2.8.8
11	Short circuit time limit	T_{LIM}	ms	50	75	See 33.2.8.9
12	Turn on rise time	T_{Rise}	µs	15		From 10% to 90% of V_{Port}
13a	Turn off time	T_{Off}	ms		500	See 33.2.8.10
13b	Turn off voltage	V_{Off}	Vdc		2.8	See 33.2.8.11
14	Continuous output power	P_{Port}	W	15.4		Over the range of output voltage. Averaged over 1 second.

Table 33–5—PSE output PI electrical requirements for all PD classes, unless otherwise specified *(continued)*

Item	Parameter	Symbol	Unit	Min	Max	Additional information
15	Current unbalance	I_{unb}	mA		10.5	See 33.2.8.12
16	Power turn on time	T_{pon}	ms		400	See 33.2.8.13
17	Detection backoff time	T_{dbo}	sec	2		PSE detection backoff time limit.
18	Output capacitance during detection mode	C_{out}	nF		520	
19	Detection timing	T_{det}	ms		500	Time to complete detection of a PD.
20	Classification timing	T_{pdc}	ms	10	75	Time to classify the PD.
21	Error delay timing	T_{ed}	ms	750		Delay before PSE may attempt subsequent powering after power removal because of error condition.

(IEEE 802.3-2008 Table 33-5).

Under the 802.3af and 802.3at Standards, power supplied by the secondary power source to the access device ("Powered End Station" / "Powered Device (PD)") is controlled in response to a preselected condition of the voltage level, consistent with Table 33.2 of the Standard.

	Identification: This element involves (a) "controlling power supplied by said secondary power source to said access device," (b) "in response to a preselected condition of said voltage level." • (a) controlling power supplied by said secondary power source to said access device: Controlling power supplied by the secondary power source (addressed above) to the access device (powered device, addressed above) is increasing, maintaining, or decreasing the power supplied by the secondary power source to the access device, either (a) via the valve or switch, or (b) by increasing the power delivered from the main power source. • (b) in response to a preselected condition of said voltage level: The power from the secondary power source is controlled based on a preselected condition of the voltage level. The preselected condition is a voltage level on the signaling pair, chosen as part of the design of the power sourcing equipment (data node), that indicates whether a powered device (access device) is able to accept remote power from the data node, whether remote power should be maintained, or whether remote power should be removed. The power sourcing equipment (data nodes) contains circuitry that examines the voltage level on the data signaling pairs in response to a series of low level currents (detection currents, addressed above). These voltage levels are compared to a set of values previously stored within the circuitry. If the signature of this series of voltage levels falls within the range of conditions which have been preselected, then the power sourcing equipment (data nodes) increases, maintains, or decreases the power over the data signaling pairs.